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(54) **APPARATUS AND METHODS FOR CONFORMABLE DIFFUSE REFLECTORS FOR SOLID STATE LIGHTING DEVICES**

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(57) **ABSTRACT**

(51) **Int. Cl.**
F21V 33/00 (2006.01)

Provided are solid state lighting devices and methods for forming the same. A solid state lighting tile according to some embodiments of the invention includes a substrate, a solid state lighting element mounted on a surface of the substrate, and a reflector sheet on the surface of the substrate. A method of forming a solid state lighting device according to some embodiments of the invention includes providing a substrate of a solid state lighting tile, mounting a solid state lighting element on a surface of the substrate, and attaching a reflector sheet to the surface of the substrate.

(52) **U.S. Cl.** **362/247**; 362/800; 362/219; 362/296.01

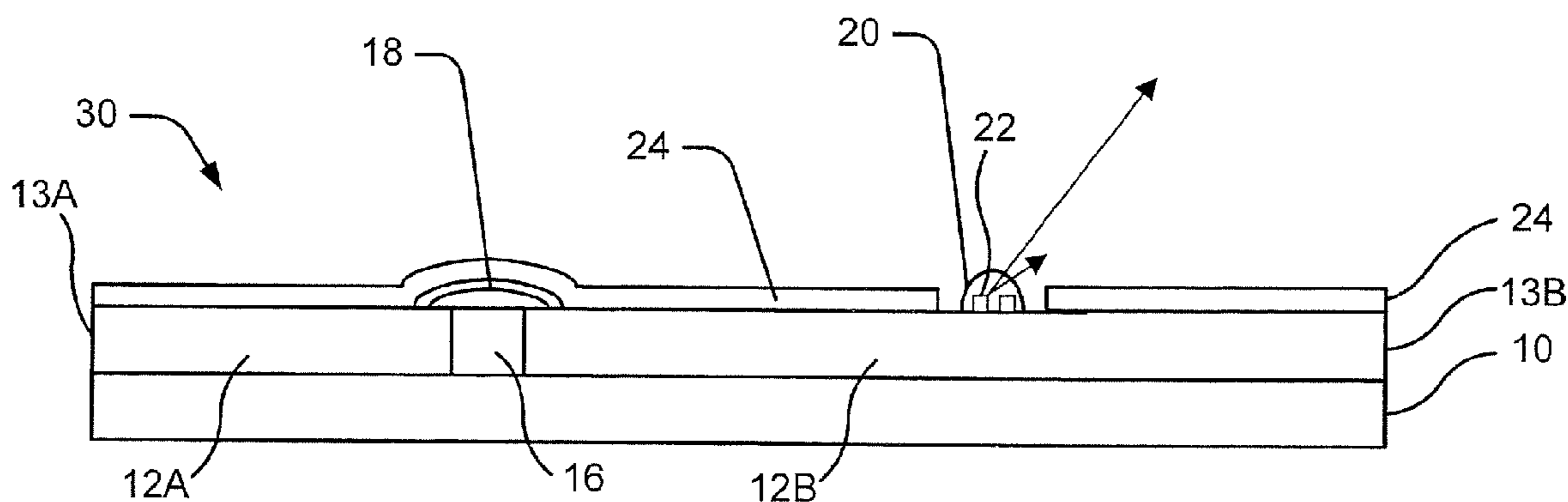
(58) **Field of Classification Search** 362/616, 362/800, 219, 238, 241, 247, 296
See application file for complete search history.

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24 Claims, 5 Drawing Sheets



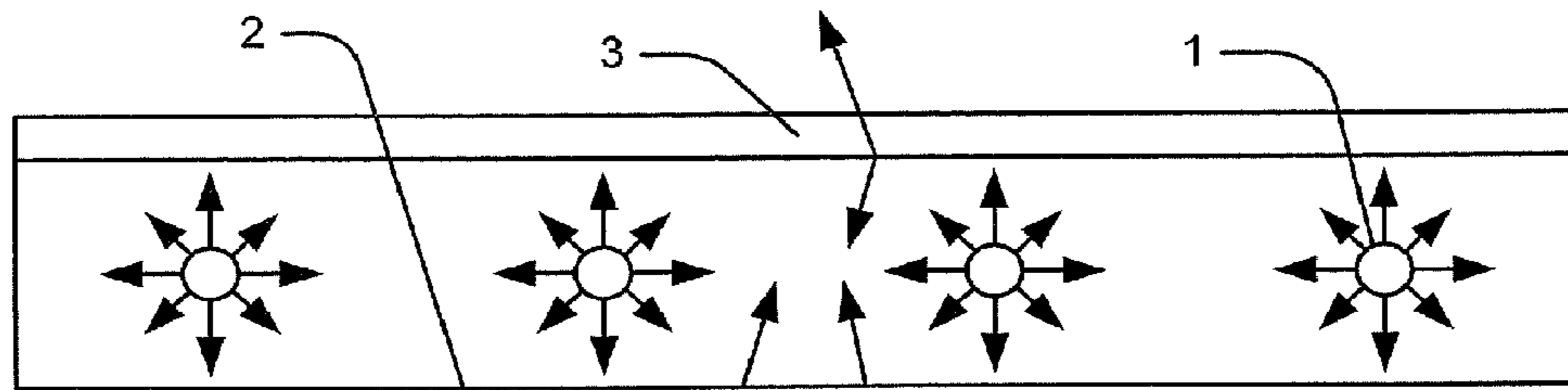


FIGURE 1
(Prior Art)

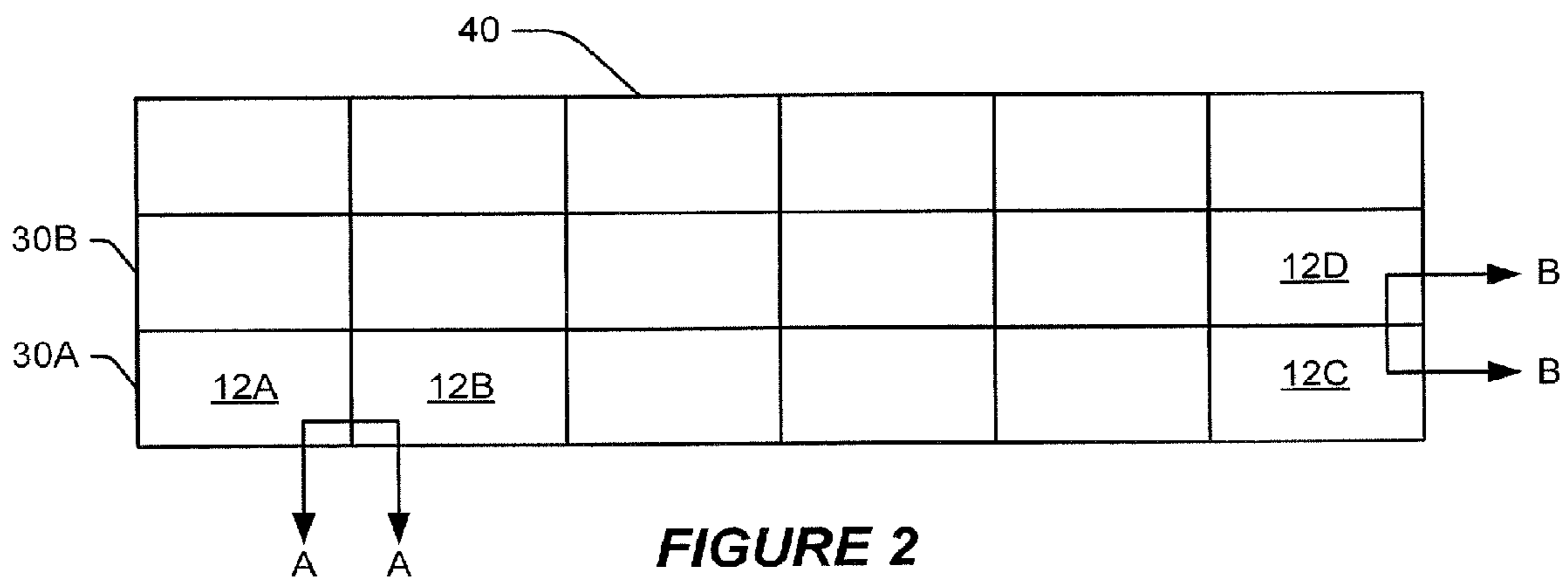


FIGURE 2

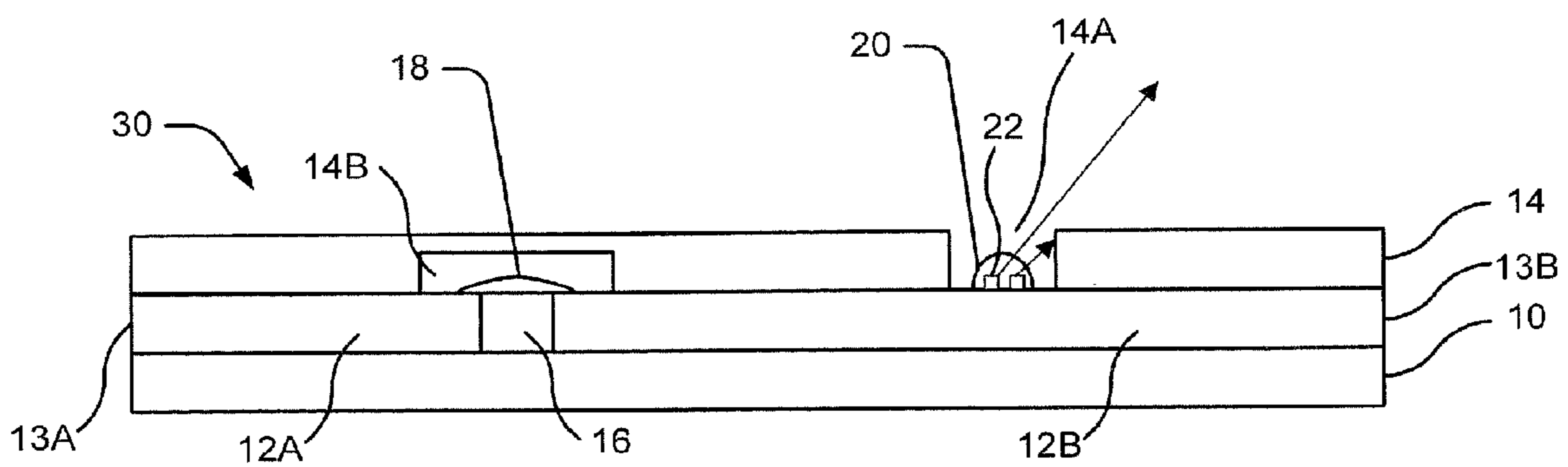


FIGURE 3

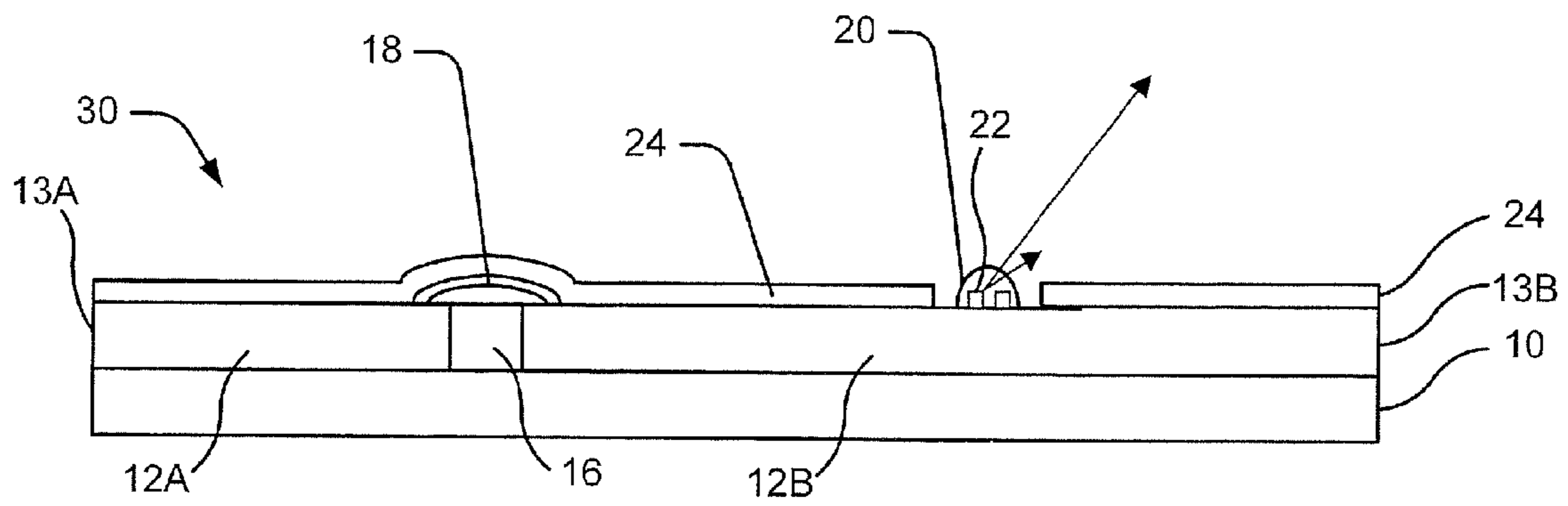


FIGURE 4

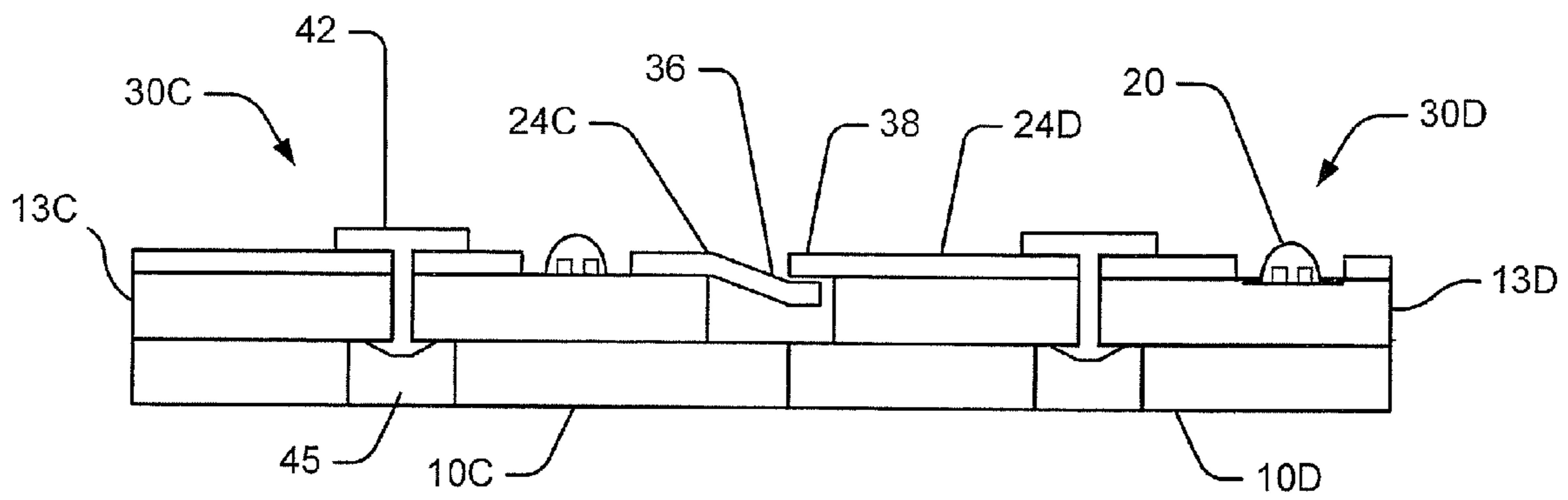


FIGURE 5A

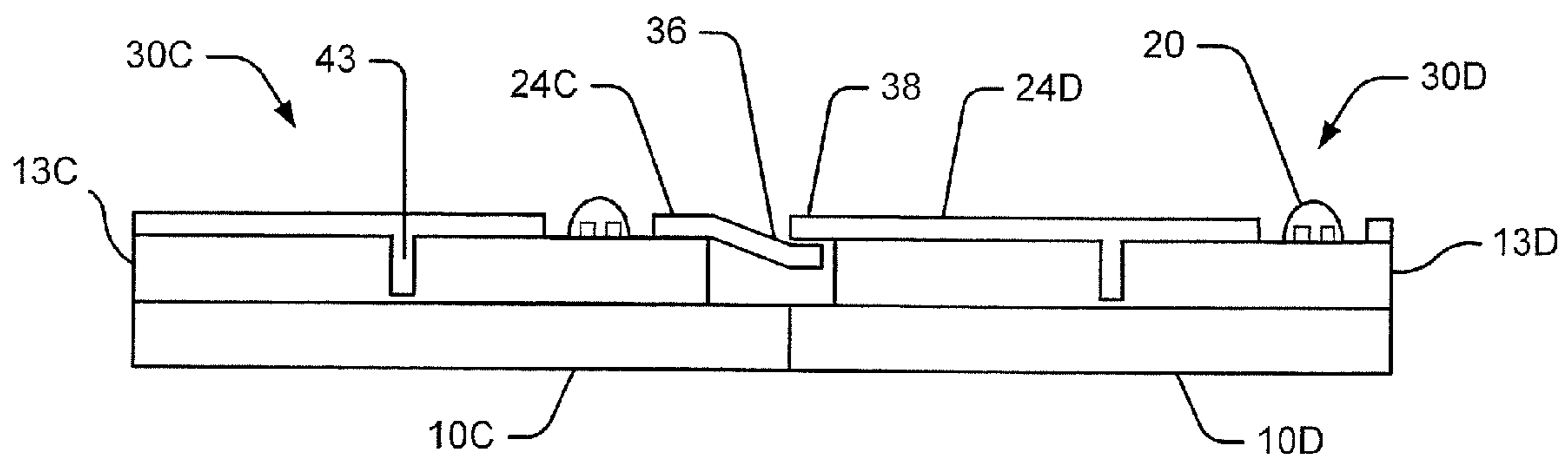


FIGURE 5B

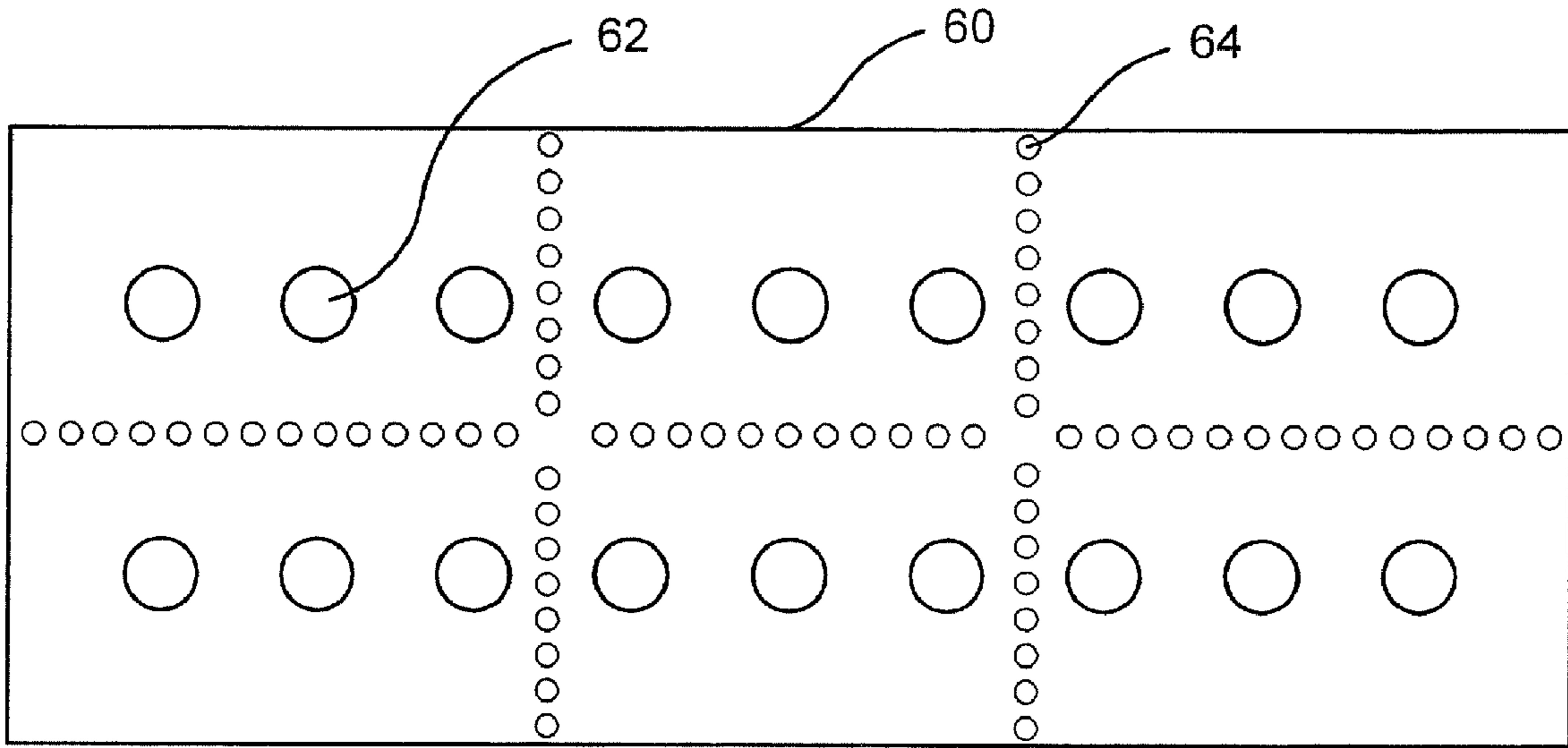


FIGURE 6

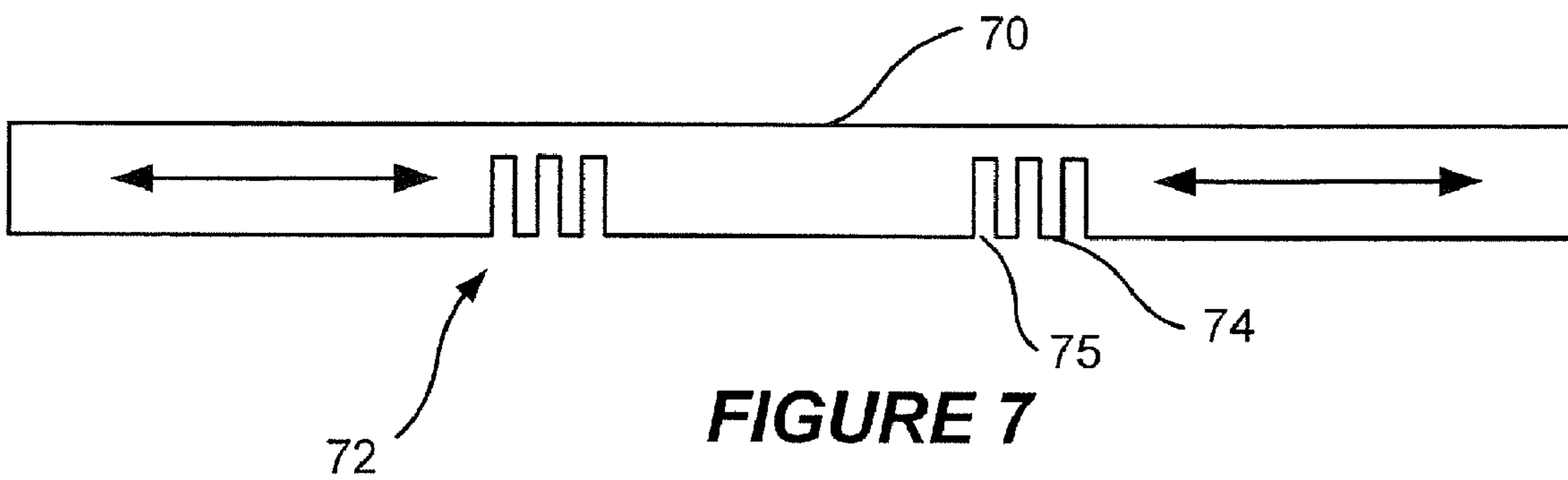


FIGURE 7

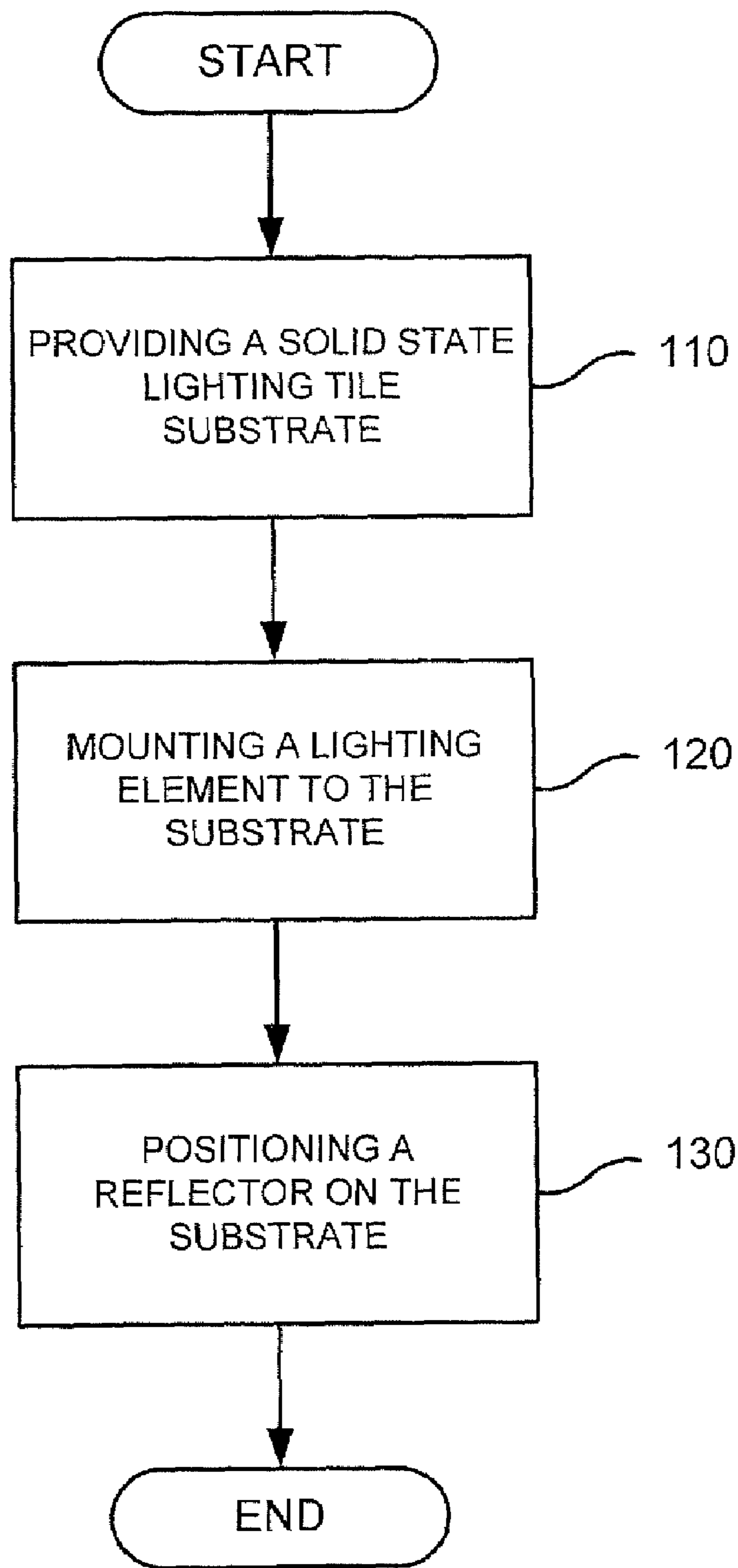


FIGURE 8

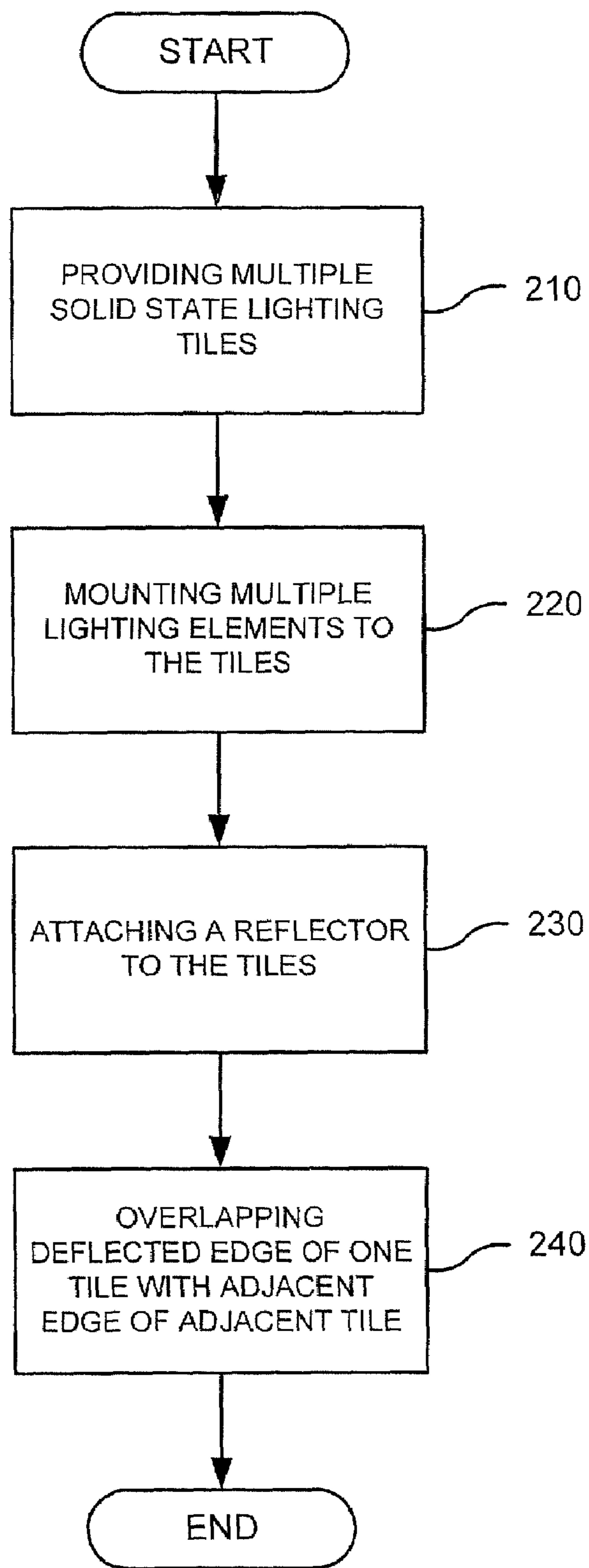


FIGURE 9

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**APPARATUS AND METHODS FOR
CONFORMABLE DIFFUSE REFLECTORS
FOR SOLID STATE LIGHTING DEVICES**

FIELD OF THE INVENTION

The present invention relates to solid state lighting, and more particularly to tiles and/or panels including solid state lighting components.

BACKGROUND

Panel lighting devices are used for a number of lighting applications. A lighting panel may be used, for example, as a backlighting unit (BLU) for an LCD display. Backlighting units commonly rely on an arrangement of cold cathode fluorescent lamps (CCFL's) within a reflective enclosure. For example, referring to FIG. 1, which is a side view of a backlighting unit of the prior art, multiple CCFL's **1** can be arranged between a reflective surface **2** and an LCD panel **3**. Light from the CCFL's **1** can be reflected from the reflective surface **2** and partially reflected from the inside surface of the LCD panel **3**. A portion of the light directed to the LCD panel **3** can be transmitted to provide illumination for the LCD panel **3**. The combination of the light directly transmitted to the LCD panel **3** from the CCFL's **1** and the reflected light from the various surfaces can create a relatively uniform backlighting unit. The CCFL's **1** however, can require higher than signal level voltages and can generate undesirable amounts of heat, which can be problematic to dissipate.

SUMMARY

A solid state lighting tile according to some embodiments of the invention includes a substrate, a solid state lighting element mounted on a surface of the substrate, and a reflector sheet on the surface of the substrate.

The reflector sheet may be a diffuse reflector and/or may be composed of a porous polymer-based material. The reflector sheet may have a thickness of less than approximately 1.0 millimeters, a thickness of less than approximately 0.50 millimeters and/or a thickness of less than approximately 0.25 millimeters.

The solid state lighting tile may further include a mechanical fastening device configured to attach the reflector sheet to the surface of the substrate. In some embodiments the mechanical fastening device can be a mechanical expansion-activated fastener. In yet other embodiments, the mechanical fastening device can include mounting posts that are integral with the reflector sheet.

A solid state lighting tile according to further embodiments can include a chemical bonding component configured to attach the reflector sheet to the surface of the substrate. The chemical bonding component can include glue and/or a pressure sensitive adhesive compound.

The reflector sheet of yet further embodiments can be configured to conform to a shape of a protruding feature on the tile. In yet further embodiments, the reflector sheet can include an aperture configured to be positioned proximate to the solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element.

A solid state lighting tile according to yet further embodiments can include a first reflector sheet that includes a first angularly deflected edge and a first adjacent edge and a second reflector sheet that includes a second angularly deflected edge and a second adjacent edge, wherein the first angularly

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deflected edge is configured to overlap the second adjacent edge when the first reflector sheet is proximate to the second reflector sheet.

In yet further embodiments, a solid state light bar includes multiple solid state lighting tiles, wherein a single reflector sheet is configured to cover the multiple tiles of the solid state light bar.

Methods of forming a solid state lighting device according to some embodiments of the invention include providing a substrate of a solid state lighting tile, mounting a solid state lighting element on a surface of the substrate, and positioning a reflector sheet on the surface of the substrate.

In some embodiments, positioning the reflector sheet may include chemically bonding the reflector sheet to the surface of the substrate and/or mechanically attaching the reflector sheet to the surface of the substrate. In some embodiments, the reflector sheet can include an aperture configured to be positioned over the solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element. In yet other embodiments, the reflector sheet is thermoformable and configured to conform to a shape of a protruding feature on the surface of the substrate.

The method may further include forming a plurality of mounting posts in the substrate and forming a plurality of alignment holes in the reflector sheet, wherein at least a portion of the alignment holes are configured to receive at least a portion of the mounting posts when the reflector sheet is attached to the surface of the substrate.

Some embodiments of the method further include providing a plurality of solid state lighting tiles, mounting a plurality of solid state lighting elements on the plurality of solid state lighting tiles, and attaching the reflector sheet to the plurality of solid state lighting tiles.

The methods may further include overlapping a top surface of an angularly deflected edge of a first reflector sheet attached to a first tile with a bottom surface proximate to an adjacent edge of a second reflector sheet attached to a second tile when the first tile is of the second tile.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate certain embodiment(s) of the invention.

FIG. 1 is a side view of a CCFL backlighting panel as known in the prior art.

FIG. 2 is a top view of a solid state lighting panel in accordance with some embodiments of the invention.

FIG. 3 is a side cross-sectional view of a solid state lighting bar in accordance with some embodiments of the invention.

FIG. 4 is a partial, side cross-sectional view of a solid state lighting bar, taken along lines A-A of FIG. 1, illustrating a reflector sheet according to some embodiments of the invention.

FIG. 5 is a partial, end cross-sectional view of a solid state lighting panel, taken along lines B-B of FIG. 1, illustrating reflector sheets according to some embodiments of the invention.

FIG. 6 is a top view of a reflector sheet according to some embodiments of the invention.

FIG. 7 is a side view of a reflector sheet according to some embodiments of the invention.

FIG. 8 is a block diagram illustrating methods of forming a solid state lighting device according to some embodiments of the invention.

FIG. 9 is a block diagram illustrating further methods of forming a solid state lighting device according to some embodiments of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Embodiments of the present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element, without departing from the scope of the present invention. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

It will be understood that when an element such as a layer, region or substrate is referred to as being “on” or extending “onto” another element, it can be directly on or extend directly onto the other element or intervening elements may also be present. In contrast, when an element is referred to as being “directly on” or extending “directly onto” another element, there are no intervening elements present. It will also be understood that when an element is referred to as being “connected” or “coupled” to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being “directly connected” or “directly coupled” to another element, there are no intervening elements present.

Relative terms such as “below” or “above” or “upper” or “lower” or “horizontal” or “vertical” may be used herein to describe a relationship of one element, layer or region to another element, layer or region as illustrated in the figures. It will be understood that these terms are intended to encompass different orientations of the device in addition to the orientation depicted in the figures.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” “comprising,” “includes” and/or “including” when used herein, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms used herein should be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

The present invention is described below with reference to flowchart illustrations and/or block diagrams of methods, systems and computer program products according to embodiments of the invention. It will be understood that some blocks of the flowchart illustrations and/or block diagrams, and combinations of some blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer program instructions. These computer program instructions may be stored or implemented in a microcontroller, microprocessor, digital signal processor (DSP), field programmable gate array (FPGA), a state machine, programmable logic controller (PLC) or other processing circuit, general purpose computer, special purpose computer, or other programmable data processing apparatus such as to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

These computer program instructions may also be stored in a computer readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer readable memory produce an article of manufacture including instruction means which implement the function/act specified in the flowchart and/or block diagram block or blocks.

The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. It is to be understood that the functions/acts noted in the blocks may occur out of the order noted in the operational illustrations. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved. Although some of the diagrams include arrows on communication paths to show a primary direction of communication, it is to be understood that communication may occur in the opposite direction to the depicted arrows.

A solid state lighting device may include, for example, a packaged light emitting device including one or more light emitting diodes (LEDs). For example, referring to FIG. 2, a solid state lighting panel 40 can include multiple solid state lighting bars 30A, 30B that can further include multiple solid state lighting tiles 12A, 12B.

A solid state lighting bar 30, as illustrated in FIG. 3, can include a support member 10, on which is provided solid state lighting tile substrate 13B that corresponds to solid state lighting tile 12B. The tile 12B can also include a solid state emitter 20 mounted on a surface of the substrate 13B. The emitter 20 can include one or more LED emitter chips 22 that are configured to emit light having one or more wavelengths. The tile 12B also includes a reflector sheet 14, configured to reflect and diffuse light transmitted from the emitter 20. The reflector sheet 14 can be configured to cover multiple tiles 12A, 12B of the solid state lighting panel 40. The substrates 13A, 13B can also include surface protrusions, such as, for example, a large wire interconnect (LWI) 18. A LWI 18 can be used to provide electrical interconnections for tiles 12A and 12B. Adjacent the LWI 18 can be an optional insulating plug 16 that can mechanically join and electrically insulate adja-

cent tiles **12A** and **12B**. The LWI **18** may be electrically insulated and/or protected from environmental exposure with a passivation or encapsulation material, including, for example, silicone (not shown).

After the bars **30** of tiles **12** are assembled into a two dimensional structure, a reflector sheet **14** may be mounted on the multiple bars. The reflector sheet **14** may be microcellular polyethylene terephthalate (MCPET), which may have a typical thickness of approximately 1 mm. The reflector sheet **14** may include recesses **14B** configured to provide relief for surface protrusions, such as an LWI **18**. The recesses **14B** may be molded into the reflector sheet **14** and/or created by removing material from the reflector sheet as a step in a manufacturing process. Without the recesses **14B**, the reflector sheet **14** can press against the LWI, potentially causing the LWI to break or pull away from the substrate **13**. The reflector sheet **14** may also include apertures **14A** that are configured to be aligned with the emitters **20**. Since the thickness of the reflector sheet **14** may be large compared to the size of the emitter **20**, emitted light may be partially blocked by the reflector sheet **14**. For example, low angle light that is emitted by an LED emitter chip **22** that is close to the edge of the aperture **14A** may be partially blocked while, low angle light from another LED emitter chip **22** is may not be blocked. As a result, light emitted by the lighting panel **40** may not have a uniform color in all angular directions. Furthermore, small changes in alignment of the aperture **14A** relative to the emitter **20** may have relatively large effects on the light output pattern of the lighting panel **40**.

Reference is now made to FIG. 4, which is a partial, side cross-sectional view of a solid state lighting bar **30**, taken along lines A-A of FIG. 1, illustrating a reflector sheet according to some embodiments of the invention. The solid state lighting bar **30** includes a first substrate **13A** corresponding to a first tile **12A** and a second substrate **13B** corresponding to a second tile **12B**. Each of the first and second substrates **13A** and **13B** are mounted on a support member **10**. The support member **10** can be configured to provide support for the tiles **12** that are included, for example, in the solid state lighting bar **30**. A tile **12** may include, for example, a printed circuit board (PCB) on which one or more circuit elements may be mounted. The first and second substrates **13A** and **13B** can be separated by an insulating plug **16**, that can be configured to mechanically join and electrically insulate the first and second tiles **12A** and **12B**.

The solid state lighting bar **30** can also include one or more large wire interconnects **18** (LWI)'s that can be positioned, for example, proximate to an insulating plug **16**. The LWI **18** is but one example of a surface protrusion that can occur on a surface of the tile substrate. Although illustrated as a protrusion, in some embodiments the LWI **18** may be flush with the surface of the tiles **12**, in which case the relief are **14B** may be unnecessary. A solid state emitter **20** can be mounted on a surface of the substrate **13B**. The solid state emitter **20** can include multiple LED emitter chips **22**, which can be configured to emit light having one or more wavelengths.

A reflector sheet **24** can be positioned on the substrate **13** of one or more tiles **12**. For example, the reflector sheet **24** can be configured to cover a single tile **12** and/or a solid state lighting bar **30**. In some embodiments the reflector sheet **24** may be positioned directly on the substrate. In some embodiments, the reflector sheet **24** may be attached to a housing and not attached to the substrate. For example, the reflector sheet **24** may be bonded to a support structure near the edges of the reflector sheet **24**. While the solid state lighting bar **30** shown in FIG. 1 is a one dimensional array of tiles **12**, other configurations are possible. For example, the tiles **12** could be

connected in a two-dimensional array in which the tiles **12** are all located in the same plane, or in a three dimensional configuration in which the tiles **12** are not all arranged in the same plane. Furthermore, the tiles **12** need not be rectangular or square, but could, for example, be hexagonal, triangular, or the like. In this manner, the reflector sheet **24** that is configured to cover a single tile **12**, can be used in a variety of solid state lighting bar **30** and/or lighting panel **40** configurations.

The reflector sheet **24** can be held in place on the tile **12** and/or bar **30** using mechanical and/or chemical bonding techniques. Chemical bonding can include, for example, pressure sensitive adhesive and/or glue. Examples of mechanical techniques include rivets, heat stakes, push-pins, and/or mounting posts that are formed as an integral part of the reflector sheet **24** and/or substrate **13**. Mounting posts can be formed using, for example, injection molding manufacturing techniques.

The reflector sheet **24** can be a diffuse reflector and can be formed using a microporous structure of a polymer material, such as micro-cellular polyethylene terephthalate (MCPET) that is commercially available from Furukawa Electric Co., Ltd. In some embodiments, while not thermoformable, DRP® reflectors that are commercially available from W. L. Gore and Associates, Inc. may be used as a reflector sheet **24**. In some embodiments, the reflector sheet **24** may be a sheet and/or film that is polymeric, elastomeric, thermoplastic and/or thermoset, among others. The reflector sheet **24** can be used in thicknesses including approximately 1.0 millimeters, approximately 0.50 millimeters and approximately 0.25 millimeters, for example. The small thickness of the reflector sheet **24** relative to the emitter **20** can result in a reduction of low-angle light blocking, which may provide for better color uniformity of the solid state lighting panel **40**. Additionally, the reflector sheet **24** includes a deformation characteristic that can provide conformance to surface protrusions such as an LWI **18**. Further, since the reflector sheet **24** can be attached to individual tiles **12** and/or solid state lighting bars **30**, assembly of the solid state lighting panel **40** may be simplified.

Reference is now made to FIGS. 5A and 5B, which are partial, end cross-sectional views of a solid state lighting panel **40** taken along lines B-B of FIG. 1 and illustrating a conformable reflector sheet according to some embodiments of the invention. The lighting panel **40** includes solid state lighting bars **30C** and **30D**, which each include support members **10C** and **10D**, substrates **13C** and **13D**, and reflector sheets **24C** and **24D**. The solid state lighting bars **30** of FIG. 5A can also include plastic rivets **42** configured to hold the reflector sheets **24** in place relative to the substrates **13**. The rivets **42** can include retention flanges that can contact a bottom side of the substrates **13C** and **13D**. The support members **10C** and **10D** can include recesses **45** corresponding to the retention flanges of the rivets **42**. As illustrated in FIG. 5B, the solid state lighting bars **30** can also include reflector sheets **24** having integrated push-pins **43** that are formed as portions of the reflector sheets **24** to hold the reflector sheets **24** in place relative to the substrates **13**. For example, the reflector sheet **24** may be injection molded such that the rivet **42** is a component of the reflector sheet **24**. In this manner, the reflector sheet **24** can be snapped onto the bar **13** via the rivets **42** and/or push-pins **43**. In some embodiments, the solid state lighting bars **30** can include integrated rivets and/or nonintegrated push-pins (not illustrated).

In some embodiments, the push-pins **43** may be formed of a white colored material, such as nylon and/or the same material as the reflector sheet **24**, for example, PET plastic. In that way, the push-pin **43** may provide the same or similar reflec-

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tance as the reflector sheet 24, thereby providing a more uniform light output. Moreover, since the function of the push-pins 43 may only be to hold the lightweight reflector sheet 24 in place on the solid state lighting bar 30, the push-pins 43 may grip the reflector sheet 24 relatively lightly, an
5 may not significantly deform the surface of the reflector sheet 24, thereby potentially improving the uniformity of the light output.

The head of a rivet 42 and/or push-pin 43 may have a low profile, such that the head may be positioned nearly flush with the reflector sheet 24 when the rivet 42 is in place. Accordingly, the rivet 42 and/or push-pin 43 may act as a functional extension of the reflector sheet 24. Furthermore, the head of the rivet 42 and/or push-pin 43 may be made low so as not to substantially shadow light emitted from an emitter on a solid state lighting bar 13.
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While rivets and push-pins are discussed, a variety of mechanical expansion-activated fasteners may be used. Additionally, each reflector sheet 24C may include an angularly deflected edge 36 that may be configured to be overlapped by an adjacent edge 38 of a reflector sheet 24D on an adjacent tile 12. By way of example, the adjacent edge 38 may be undeflected and/or deflected in a similar or complementary manner.
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Brief reference is now made to FIG. 6, which is a top view of a reflector sheet according to some embodiments of the invention. The reflector sheet 60 includes multiple apertures 62 for receiving emitters on one or more solid state lighting bars. The reflector sheet 60 also can include multiple perforation apertures 64 that may be configured in patterns arranged in one or more dimensions across the reflector sheet 60. The perforation apertures 64 can serve to provide designated expansion zones in the event that the solid state lighting bars experience thermal expansion and/or contraction. In this manner, expansion and/or contraction can be isolated to the designated expansion zones in order to reduce buckling, warping, and/or distortion that might undesirably affect uniformity.
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Thermal expansion zones may also be created by varying the thickness of the reflector sheet 70, as illustrated in FIG. 7, which is a side view of a reflector sheet according to some embodiments of the invention. The reflector sheet 70 may include expansion zones 72 configured to provide designated areas in which thermal expansion and/or contraction can occur. The expansion zone 72 can include multiple ribs 74 that define channels 75 having a reduced thickness. By defining an expansion zone 72, the reflector sheet 70 can be more capable of expanding and/or contracting with changes in temperature without excessive stress or deformation.
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Reference is now made to FIG. 8, which is a block diagram illustrating a method of forming a solid state lighting device according to some embodiments of the invention. A solid state lighting tile substrate is provided (block 110). The substrate can be mounted on, for example, a support member that is configured to support one or more tile substrates. Multiple tiles can be configured as a solid state lighting bar, which can, in combination with other solid state lighting bars, be configured as a solid state lighting panel.
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A lighting element is mounted to the substrate (block 120). The lighting element can be a solid state emitter that can include one or more LED emitter chips. In some embodiments, each of the LED emitter chips can be configured to transmit light at specific wavelengths. A reflector sheet can be positioned on the substrate (block 130). In some embodiments, the reflector sheet may include materials that are formable including, for example, thermoformable materials. The reflector sheet can include one or more apertures configured
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to be aligned with lighting elements. The reflector sheet can also be configured to conform to protrusions on the surface of the substrate, such as LWI's, for example. In some embodiments, the reflector sheet can have a thickness less than approximately 1.0 millimeter. In some embodiments, the reflector sheet can have a thickness less than approximately 0.50 millimeters.
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Reference is now made to FIG. 9, which is a block diagram illustrating further methods of forming a solid state lighting device according to some embodiments of the invention. Multiple solid state lighting tiles are provided (block 210). The tiles can be supported by, for example, a support member that corresponds to a solid state lighting bar. Multiple lighting elements are mounted to the tiles (block 220). The lighting elements can be solid state emitters that can include one or more LED emitter chips. A reflector sheet is attached to the multiple tiles (block 230). The reflector sheet can include apertures that are configured to be aligned with the lighting elements. In some embodiments, the reflector sheet can have a thickness of less than approximately 0.25 millimeters. Additionally, the reflector sheet may be configured to conform to protrusions on the surface of the tile substrate. In this manner, recesses may not have to be created or formed in the reflector sheet during manufacturing. A deflected edge of a reflector sheet on a first tile is made to overlap an adjacent edge of the reflector sheet of an adjacent tile (block 240). The adjacent edge can be undeflected or deflected in a similar or complementary manner, for example. In this manner, the reflector sheet of the first tile is overlapped by the reflector sheet of the second tile when the tiles are assembled to create a display or panel.
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In the drawings and specification, there have been disclosed typical embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.
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That which is claimed is:

1. A solid state lighting tile, comprising:

a substrate;

a solid state lighting element mounted on a surface of the substrate; and

a reflector sheet on the surface of the substrate, the reflector sheet configured to conform to a shape of a protruding feature on the tile.
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2. The tile of claim 1, wherein the reflector sheet comprises a diffuse reflector.

3. The tile of claim 1, wherein the reflector sheet comprises a polymer-based porous material.

4. The tile of claim 1, wherein the reflector sheet comprises a thickness of less than approximately 1.0 millimeter.

5. The tile of claim 1, wherein the reflector sheet has a thickness of less than approximately 0.50 millimeters.

6. The tile of claim 1, wherein the reflector sheet has a thickness of less than approximately 0.25 millimeters.

7. The tile of claim 1, further comprising a mechanical fastening device configured to attach the reflector sheet to the surface of the substrate.

8. The tile of claim 7, wherein the mechanical fastening device comprises a mechanical expansion-activated fastener.

9. The tile of claim 7, wherein the mechanical fastening device comprises mounting posts that are integral with the reflector sheet.

10. The tile of claim 1, further comprising a chemical bonding component configured to attach the reflector sheet to the surface of the substrate.
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11. The tile of claim 10, wherein the chemical bonding component comprises glue and/or a pressure sensitive adhesive compound.

12. The tile of claim 1, wherein the reflector sheet comprises an aperture configured to be positioned proximate to the solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element.

13. A solid state lighting tile, comprising:
a substrate;
a solid state lighting element mounted on a surface of the substrate; and
a reflector sheet on the surface of the substrate wherein the reflector sheet comprises an aperture configured to be positioned proximate to the solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element, and
wherein a first reflector sheet comprises a first angularly deflected edge and a first adjacent edge and a second reflector sheet comprises a second angularly deflected edge and a second adjacent edge, wherein the first angularly deflected edge is configured to overlap the second adjacent edge when the first reflector sheet is proximate to the second reflector sheet.

14. A solid state light bar comprising a plurality of tiles according to claim 1, wherein a single reflector sheet is configured to cover the plurality of tiles of the solid state light bar.

15. A method of forming a solid state lighting device comprising:
providing a substrate of a solid state lighting tile;
mounting a solid state lighting element on a surface of the substrate; and
positioning a reflector sheet on the surface of the substrate, the reflector sheet configured to conform to a shape of a protruding feature on the solid state lighting tile.

16. The method of claim 15, wherein positioning the reflector sheet comprises chemically bonding the reflector sheet to the surface of the substrate.

17. The method of claim 15, wherein positioning the reflector sheet comprises mechanically attaching the reflector sheet to the surface of the substrate.

18. The method of claim 15, wherein the reflector sheet comprises an aperture configured to be positioned over the

solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element.

19. The method of claim 15, wherein the reflector sheet is thermoformable and configured to conform to a shape of a protruding feature on the surface of the substrate.

20. A method of forming a solid state lighting device comprising:
providing a substrate of a solid state lighting tile;
mounting a solid state lighting element on a surface of the substrate;
positioning a reflector sheet on the surface of the substrate;
forming a plurality of mounting posts in the substrate; and
forming a plurality of alignment holes in the reflector sheet, wherein at least a portion of the alignment holes are configured to receive at least a portion of the mounting posts when the reflector sheet is attached to the surface of the substrate.

21. The method of claim 15, wherein the reflector sheet comprises a diffuse reflector.

22. The method of claim 15, wherein the reflector sheet comprises:
a micro-porous polymer; and
an expansion zone configured to provide a designated area for expansion.

23. The method of claim 16, further comprising:
providing a plurality of solid state lighting tiles;
mounting a plurality of solid state lighting elements on the plurality of solid state lighting tiles; and
attaching the reflector sheet to the plurality of solid state lighting tiles.

24. A method of forming a solid state lighting device comprising:
providing a substrate of a solid state lighting tile;
mounting a solid state lighting element on a surface of the substrate;
positioning a reflector sheet on the surface of the substrate; and
overlapping a top surface of an angularly deflected edge of a first reflector sheet attached to a first tile with a bottom surface of an adjacent edge of a second reflector sheet attached to a second tile when the first tile is proximate to the second tile.

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